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ABSTRACT

The ability of children to process words printed in a second language was studied over the course of a school year as the children acquired increasing familiarity with the language. The children, ranging in age from 5 to 15 years, represented four ability groups with respect to their reading skills in their first and second languages. A picture-word interference task assessed the degree to which children processed word meaning automatically. The task required children to name pictures in their first language while ignoring distractor words printed within the pictures' borders. On same-language (SL) trials, the printed distractor words appeared in the child's first language. On cross-language (CL) trials, the distractor words appeared in the child's second language. The results indicated that second language words were automatically processed to the level of meaning early in the course of second language reading instruction. Both the pattern and the amount of CL interference generally matched that for SL trials. The common pattern of interference for both the SL and CL manipulations across several conditions that varied the picture-word meaning relation suggested that a superordinate conceptual representation served both language lexicons. (Author/AMH)

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Reading in a Second Language:
Automatic Processing of Word Meaning

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Reading in a Second Language:

Automatic Processing of Word Meaning

Accomplished readers normally process the words they read automatically. The words they see generate psychological meaning effortlessly, without the explicit sound decoding seen in beginning readers. Automatic processing of words develops relatively quickly after a child begins to read: several researchers have demonstrated automatic processing of single words by second grade (Golinkoff & Rosinski, 1976; Rosinski, 1977) and Guttentag and Haith (1978) found evidence of automatic word processing by the seventh month of first grade. A picture-word interference task was used to index automatic processing in these studies. Modeled after the Stroop test, the picture-word interference task requires subjects to name pictures while ignoring distractor words printed within the picture's borders. The effect on picture-naming latency of the distractor is taken as a measure of the amount of interference (i.e., automatic contact with meaning) the distractor produces. The fact that within-category distractors produce more interference than between-category distractors suggests that the effect occurs within semantic memory (Guttentag & Haith, 1978; Rosinski, 1977).

We have been concerned with the development in children of automatic processing of printed words as they learn to read a second language. The present research addresses several questions about language processing. Does automatic processing develop in the same way in the second as in the native language? How integrated are the conceptual representation systems serving the first, and second language lexicons? And, can subjects suppress semantic processing in one language while operating in the second language?

These issues were examined in a longitudinal study of picture-word interference for first and second languages. Subjects of varying initial levels of second-language fluency were tested three times during the course of a year in which they were engaged in intensive second-language study. We were interested in examining differences in automatic processing of second-language words as a function of the children's initial level of second-language fluency and in tracing changes in automatic word processing as the children acquired greater second-language fluency. We used six distractor conditions with the picture-word interference task to study these issues. The distractor conditions varied the relation between the picture and the word along a continum of meaning. At one end of the continum, there was no meaning relation; that is, pictures contained no printed information. At the other extreme, the distractor word matched the picture in meaning. Between these two end-points conditions were presented that represented varying degrees of picture-word relations. In order of increasing meaning of intermediate conditions were: nonpronounceable pseudo-words, pronounceable pseudowords, between-category words (in which the words were chosen from a different semantic category than were the pictures), and within-category words (in which the words were chosen from the same semantic category as were the pictures). The choice of these distractor conditions permitted us to separate the interference produced by including letters, pronounceability words, and semantic categories. The letter and prounceability conditions permit an assessment of the amount of interference produced by random letter strings and pronounceability apart from "wordness", per se, or their category membership.

The picture-word interference task was also employed to produce a conflict between the subject's first and second language systems. The conflict was produced by asking the child to name pictures in the first language with distractor words printed in the second language. To the extent that the second language words delay picture naming, cross-language interference can be inferred. The pattern of cross-language (CL) interference evidenced across the six distractor conditions can be compared with the pattern evidenced across the same conditions on same-language (SL) trials. On SL trials, subjects are also asked to name pictures in their first language, but the printed distractor words are written in the first rather than the second language.

By including both CL and SL trials, several issues can be addressed. First, the presence of CL interference would suggest that second language words are not being translated into the first language for abstraction of word meaning; such translation should be easily suppressable in the face of instructions to ignore the printed words. Therefore, the occurence of CL interference implies that the meaning of second language words is processed automatically and directly.

Second, the occurrence of both CL and SL semantic interference would imply that a superordinate conceptual representation system serves both first and second language lexicons. Semantic intereference is inferred in the picture-word task when within-category distractors (e.g. the word "horse" paired with the picture of a cow) produce more interference than between-category words (e.g. the word "boat" paired with the picture of a cow). CL semantic interference would imply that word and picture name are processed by a shared representation system in which the two meanings compete for the subject's processing and/or verbal response. Alternatively,

if independent representation systems serve each language lexicon, within-category words should produce relatively less unique interference on CL trials. This argument follows because on CL trials the meaning of distractor words and picture names would be processed in representation systems that would be less likely to compete (see Albert & Obler, 1978; Kolers, 1966; Tulving & Colotla, 1970).

Finally, we were interested in the comparison of SL and CL trials for the condition in which word and picture names were semantically congruent. On SL trials, congruent words should facilitate naming since the picture and the word are identical in meaning and in sound: the two sources of input contribute both to lexical access and the same correct response. On CL trials, the word and picture match in meaning. Thus, facilitation of semantic access should occur. On the other hand, the printed word does not map directly onto the correct response. Thus, one might expect faster naming than for the CL word conditions but slower naming than for the comparable SL conditions.

Method

Subjects

The experiment was conducted during the 1978-1979 school year at the Lycée Internationale, a French public school located in Saint Germain-en-Laye, a suburb of Paris, France. The Lycée educates children from nursery school age through the first year of college and specializes in second-language instruction. Half of the enrolled children held a foreign nationality and were learning French as a second language: the other half were French and learning another language as a second language. We were interested in the American and British children learning French and the French children learning English.

A total of 96 children were intially tested. Of these, 15 were later excluded because of incorrect language classification, 8 were excluded because they left the Lycée before Session 3 could be completed, and 4 were excluded because they did not learn to read during the school year. Thus, a total of 69 children completed all three sessions of the study, and it is only their data that are reported here.

To ensure selection of children who were second language learners and not bilinguals, our sample was drawn from classes specially designated for children not yet proficient in their second language, the "Anglais" and "Française Speciale" classes. Their placement in these classes was determined by second language screening tests administered by the Lycée at the beginning of the school year. The purpose of these classes was to raise the children's verbal, written, and reading fluency to a level that would permit their participation in regular academic classes (e.g., math, literature) conducted entirely in the second language. Anglais and Française Speciale classes were held at each grade level. We were therefore able to sample a wide age range (5-0 to 15-3 years) of children who were in their early stages of learning a second language. Ideally, this arrangement would have provided a natural experiment in which age and second language experience were factorially combined. Instead, a positive correlation existed between the age of the child and facility with the second language. In order to separate the effects of language facility and age, the children were divided into four ability groups based on the number of first and second language words they could correctly identify at the start of the study on two picture-word matching tasks. The picture-word matching tasks (described below) required the

subject to choose, from a mix of English words and non-words, the words that matched a set of pictures. The words and pictures were the same as those used on the picture-word interference task. The mean number of words correctly identified on the picture-word matching task by the four ability groups at each testing session is presented in Table 1.

Insert Table 1 about here

Group A - Prereaders. At the start of the study, the age of the 13 children in Group A averaged 6-2 years (range: 5-0 to 7-0 years). Only three of the children were native speakers of English; the rest were native speakers of French. Performance on the picture-word matching task at Session 1 indicated that the children were best characterized as prereaders. Only a few of the children could identify any of the words written in their first language. None of the children could identify a single word written in their second language. Over the course of the year, these children learned to read simple words in both languages. Progress was greatest for first language words. The children were not totally naive to their second language since they averaged 2-5 years (range: 2-0 to 3-0 years) of experience with it as indicated from parental reports. The experience was, however, quite limited in nature and generally restricted to nursery school games and songs.

Group B - First Language-Only Readers. Eight children qualified as first language-only readers. When the study began, the mean age of these children was 8-1 years (range: 6-8 to 10-9 years). Five of the children

were native speakers of English, while the remaining were native speakers of French. Group B consisted of children who at Session 1 could read nearly all of the 12 words in their first language but only 7 or fewer words in their second language. By Session 3, these children could read virtually all the words in both languages. Parental reports indicated that the children had already experienced a mean of 1-6 years (range: 0-2 to 4-3 years) of experience with their second language when the experiment began.

Group C - Intermediate Second Language Readers. The mean age of the 27 children in Group C was 10-2 years (range: 6-10 to 15-3 years). Twelve of the children were native speakers of English and 15 were native speakers of French. The children in Group C could correctly identify virtually all of the first language words on the picture-word matching task at Session 1. The children could also identify 8 to 11 of the second language words. By the second testing session, these children could read virtually all of the words on both picture-word matching tasks. Parental reports indicated that the children averaged 2-2 years (range: 0-2 to 6-0 years) of experience with their second language at the beginning of the experiment.

Group D - Advanced Second Language Readers. The mean age of the 21 participants in Group D was 10-2 years (range: 7-6 to 15-0 years). Eight of the children were native speakers of English, while thirteen were native speakers of French. The children could correctly identify all of the words on both picture-word matching tasks at Session 1. While these children correctly identified all of the words used in the study, they were far from bilingual as judged by the number of years of school and home experience with their second language ($\underline{M}$ = 2-7 years; range: 0-2 to 5-2 years), and by their placement in "Speciale" classes.

The prereaders were of interest to the study since they possessed a natural semantic basis for learning to read in their first language but little semantic basis for learning to read in their second language. Group B was of interest since these children could already read in their first language when the study began. But, verbal and reading skills in their second language were quite poor. The children in Group C were of interest because of their initially intermediate level of competence in reading the second language words used in the study. Finally, Group D was of interest since the children in this group could read all of the words from the start. We could therefore determine whether the beginning and the advanced second language learners evidenced both SL and CL interference and whether their pattern of interference changed over the course of the three sessions.

Stimulus Materials

The pictures for the picture-naming task were 12 line drawings from four categories: 1. parts of the body (leg, hand, and foot); 2. food (milk, egg, and apple); 3. celestial objects (moon, cloud, and star); and 4. animals (dog, bear, and cow). The category exemplars were chosen after extensive screening. We selected only items that were familiar to children of all ages and nationality. Furthermore, the name of the item could not be a cognate nor visually or acoustically confusable with any other noun either within or between languages. The names of the items did not exceed six letters in either language.

The pictures were drawn on sheets of paper. Each sheet contained the same 12 pictures but in different positions and with different kinds of distractors. The distractors were words or nonsense letter-strings typed

in lower case in the center of the picture. Six sheets were used for the French-distractor language condition and six for the English-distractor language condition. Within each language distraction condition, the six sheets corresponded to one of the following distraction conditions:

1) Blank. Each picture appeared with no printed material;

2) Non-pronounceable pseudowords. Each picture contained a non-pronounceable letter string created by substituting consonants for vowels in the pronounceable pseudowords;

3) Pronounceable pseudowords. Each picture contained a pronounceable nonsense word that obeyed orthographic rules within the language. These nonsense words were matched to the picture-name words in letter frequency and length;

4) Between-category distraction. Each of 12 pictures contained a name from a different category, e.g., "dog" or "chien" written inside a picture of a foot;

5) Within-category distraction. Each of the 12 pictures contained the name of another picture from the same category, e.g., "dog" or "chien" written inside a picture of a cow;

6) Congruent. Each picture contained the correct name of the picture.

In addition to these stimulus materials for the primary task, two sheets were prepared for a picture-word matching task, one with French words and one with English words. A list of the 12 experimental words mixed with a list of 12 anagrams of these words, appeared in one column on the left hand side of the page. The anagrams began with the same letter as the original word. On the right hand side of the page were the 12 experimental pictures, also

in a single column. A separate set of two pages was prepared for each child as the task required the subject to draw a line from each picture to its appropriate label.

Design

A 4 (Ability Group) X 3 (Sessions) X 2 (Distractor Language) X 6 (Distractor Conditions) factorial design was employed. Ability group (Groups A, B, C, and D) was the only between-subject factor, while sessions (1, 2, and 3), distractor language (English vs. French), and distractor conditions (blank, non-pronounceable pseudowords, pronounceable pseudowords, between-category words, within-category words, and congruent) were varied within-subjects. The three sessions were conducted in October, 1978, March, 1979, and June, 1979: for our purposes, subjects maintained their initial ability group designation throughout the study regardless of their performance on the picture-word matching task at Sessions 2 and 3. The distractor-language factor refers to the language in which the words inside the pictures were printed. It does not refer to the language spoken by the child; because the children were still learning their second language, the children always named the pictures in their first language. The order in which the two distractor-language conditions appeared was counterbalanced across subjects. The distractor-conditions factor refers to the type of distractor used in the picture-word interference task. Six orders were determined and counterbalanced across subjects.

Procedure

The children were seen individually. Three different experimenters, bilingual in French and English, each took responsibility for one of the three sessions. At each session, the child was told that s/he would be

shown 12 pictures on sheets of paper and that s/he should try to name the pictures as rapidly as possible. The child was cautioned that sometimes letters would appear inside the pictures but that these should be ignored since they would only slow naming if attended. Instructions were always given and naming always elicited in the child's first language.

Two practice sheets were given before actual testing commenced. The first sheet contained the pictures only. Children named the pictures and were corrected and retested if discrepancies in word choice occurred. The second practice sheet corresponded to the non-pronounceable pseudoword condition. The subject was again asked to name the pictures as rapidly as possible and to ignore the letters inside the pictures.

Subjects were then presented 12 sheets in sequence, 6 from one distractor language condition (e.g., the letters and words inside the pictures were from the French distractor language condition) and 6 from the other distractor language condition. The order of the distractor conditions remained the same across the two distractor language conditions. The time required to name the 12 pictures on a sheet was recorded with the aid of a hand-held stop watch: errors were noted and each session was audiotaped. A consistent subjective impression was shared by the experimenters: the children were trying very hard to name the pictures and to ignore the printed words, even to the point of manifesting considerable frustration when the words interfered.

After the picture-word interference task was completed, the picture-word matching task was administered. A sheet containing the experimental words, mixed with anagrams, and the experimental pictures was presented to the child. The child was warned that there were some "mixed-up" words on

the list, but that s/he should try to find the real words and to draw a line from the real word to the correct picture. The child worked on the sheet for one language first and then on the sheet for the other language (order of English and French sheets were counterbalanced across subjects).

After the picture-word matching task was completed, the child was interviewed concerning her/his language experience, the languages spoken at home by each parent, and the number of years of formal language training in school so far completed. Children received a "bon-bon" for their efforts. The entire testing period encompassed approximately 20 minutes.

The children's teachers filled-out questionnaires concerning the child's language competence in French and English, and parents filled-out questionnaires about their own and their children's language experience.

Results

Performance was analyzed separately for each of the four ability groups. For each subject, the latency to name the 12 pictures on a sheet was entered into a 3 (session) X 2 (distractor language) X 6 (distractor condition) analysis of variance. Sessions (first, second, and third), distractor language (English vs. French), and distractor condition (blank, onpronounceable pseudowords, pronounceable pseudowords, between-category, within-category and congruent) all varied within-subjects. The analyses of variance were followed by planned comparions. Figure 1 presents the mean naming latencies from Groups A, B, C, and D on the SL and CL distractor condition trials for each of the three sessions. Table 2 presents the same data collapsed across sessions.

Insert Figure 1 and Table 2 about here

Group A

At the start of the study, children in Group A could not read the 12 words in either language. While the number of words they could read increased across the three sessions, interference on the picture-word interference task was first reliably evidenced only in Session 3. This can be seen in Figure 1. The one exception to this rule occurred on the CL trials of Session 2 in which the between-category words produced reliably greater latencies than the pronounceable pseudowords, $F(1,120) = 4.27$, $p < .05$ (planned comparison), indicating some interference unique to words. Reliable sessions X distractor conditions, $F(10,120) = 2.83$, $p < .01$, and sessions X distractors language X distractor conditions, $F(10,120) = 3.64$, $p < .01$, interactions indicated a change in the interference pattern over sessions. The main effect of conditions, $F(5,60) = 6.57$, $p < .001$, was also reliable. The following planned comparisons for Group A concern performance at Session 3 only.

Interference by letters. The presence of letters produced little interference on either the SL or CL trials. When the blank and nonpronounceable pseudoword conditions were compared for the SL trials, only a borderline level of significance was reached, $F(1,120) = 3.5$, $p < .10$. The same compariosn on CL trials did not approach significance, $F(1,120) = .03$.

Interference by pronounceability. Comparison of the nonpronounceable pseudoword and pronounceable pseudoword conditions provides an index of interference attributable to pronounceability. The comparison was not reliable for SL, $F(1,120) = .02$, or the CL, $F(1,120) = 1.87$, trials.

Interference by words. The difference between the pronounceable pseudoword and between-category conditions can be used as a measure of inter-

ference from words. Group A children evidenced interference from words on CL trials by Session 2. By Session 3, planned comparisons revealed reliable interference from words on both SL, $F(1,120) = 21.89$, $p < .001$, and CL, $F(1,120) = 5.64$, $p < .05$, trials. Therefore, over a course of approximately 7 months of intensive exposure to printed material in the first and second languages, both SL and CL interference from words developed.

Interference by semantic categories. In order to determine if the meaning of words caused interference, the between- and within-category conditions were compared. No evidenc for semantic interference was found: SL $F(1,120) = .29$, and CL, $F(1,120) = 2.44$.

Interference by congruent words. By Session 3, an interesting and opposite effect of congruent words occurred in the SL and CL trials. Naming speed in the SL and CL congruent conditions reliably differed, $F(1,120) = 46.00$, $p < .001$. For the SL task alone naming in the congruent condition was non-significally faster than for the blank condition, $F(1,120) = 2.23$, and reliably faster relative to the other word conditions: congruent versus between-category, $F(1,120) = 62.43$, $p < .001$, and congruent versus within-category, $F(1,120) = 70.65$, $p < .001$. On CL trials, congruent words produced reliably slower naming than the blank condition, $F(1,120) = 18.24$, $p < .001$. But there was no reliable time difference between the congruent and other-word conditions; between-category, $F(1,120) = .14$, and within-category, $F(1,120) = 3.71$. A reliable distractor language X distractor conditions interaction, $F(5,60) = 4.26$, $p < .01$, resulted from the opposite effects of the congruent condition. The change in the profile of the three word conditions (within, between, congruent) from the second to the third session, a period of only 3 months, was striking and the comparison of the change in profiles for the two language conditions is especially dramatic.

SL versus CL word interference. A comparison of SL and CL word conditions measures differences in the extent to which first and second language words are automatically processed in general. If second language learners can completely shut-off processing foreign word meaning, CL word interference should be negligable. But, as automatic processing of second language words becomes more compelling, the amount of CL interference should approach that for SL trials. We compared the naming latency on the combined SL between- and within-category word conditions with that for the same conditions on CL trials. The comparison did not include the congruent word condition because of its opposite interference pattern on SL and CL trials. The comparison was restricted to the relevant data obtained on Session 3 at which time word interference for SL and CL trials was first convincingly demonstrated. At this time, first language words slowed naming significantly more than did second language words, $F(1,120) = 13.53$, $p < .001$. It should be noted, however, that only about half of the second language words could be identified by Group A children at Session 3, thus limiting the possible findings.

Group B

The children in Group B were of special interest because they could read all 12 words in their first language by Session 1 but could read relatively few words in their second language. Unfortunately, the small number of subjects who qualified for Group B membership limited the power of the statistical analyses. Nevertheless, both a main effect of distractor conditions, $F(5,35) = 19.27$, $p < .001$, and a distractor language X distractor conditions interaction, $F(5,35) = 6.68$, $p < .001$, were reliable. The main effect of sessions, $F(2,14) = 2.73$, $p < .10$, was marginally significant. Because we were interested in interference from certain specific sources, the following planned comparisons were made.

Interference by letters. The blank and nonpronounceable pseudowords conditions did not differ reliably for either the SL, $F(1,70) = .02$, or the CL, $F(1,70) = 1.34$, trials.

Interference by pronounceability. Pronounceability was not a source of interference on either SL, $F(1,70) = 1.20$, or CL, $F(1,70) = .98$, trials.

Interference by words. Words were a source of interference on both SL, $F(1,70) = 26.35$, $p < .001$, and CL, $F(1,70) = 4.35$, $p < .05$, trials when combined over sessions. As would be expected, the between-category condition produced longer latencies than the pronounceable pseudoword conditions on SL trials at each session: Session 1, $F(1,70) = 6.60$, $p < .05$; Session 2, $F(1,70) = 5.93$, $p < .05$; and Session 3, $F(1,70) = 4.43$, $p < .05$. Alternatively, the same comparison for the CL trials indicated that the stability of the effect grew somewhat over sessions, since the comparison was not reliable on Session 1 or Session 2, but was of borderline significance by Session 3, $F(1,70) = 2.80$, $p < .10$.

Interference by semantic categories. As can be seen in Figure 3, latencies for within-category interference were higher than latencies for between-category interference for SL and CL trials across all sessions. The effect approached significance for the combined SL trials, $F(1,70) = 3.45$, $p < .10$, and reached significance for the combined CL trials, $F(1,70) = 4.00$, $p < .05$. When each session was considered, the SL comparison was reliable at Session 3, $F(1,70) = 4.22$, $p < .05$, and the CL comparison was reliable at Session 2, $F(1,70) = 7.61$, $p < .01$.

Interference by congruent words. On SL trials, congruent words facilitated naming throughout the three sessions, whereas there was some evidence that congruent words produced interference on CL trials. Naming latency

was always larger on CL than on SL trials: Session 1, $F(1,70) = 4.15$, $p < .05$; Session 2, $F(1,70) = 25.87$, $p < .001$, and Session 3, $F(1,70) = 10.65$, $p < .01$. The blank versus congruent conditions differed reliably for SL trials, $F(1,70) = 33.64$, $p < .001$. To the contrary, on CL trials, the latency to name pictures in the blank and congruent conditions differed at Session 2, with congruent words producing greater latencies, $F(1,70) = 10.98$, $p < .01$. The congruent condition did reliably differ from the within-category condition, however, at both Sessions 2 and 3, $F(1,70) = 4.25$, $p < .05$, and $F(1,70) = 5.15$, $p < .05$, respectively. Thus, there was some evidence that, while congruent words facilitated naming on SL trials, they were a source of interference on CL trials by Session 2.

SL and CL word interference. The comparison of SL and CL between- and within-category word conditions was conducted for Sessions 2 and 3 combined. Session 1 was omitted because evidence for CL word interference was not compelling. A difference in the amount of interference for the SL and CL word conditions was not found, $F(1,70) = 1.76$. Thus, second language words produced as much interference as first language words on Sessions 2 and 3.

Group C

The pattern of interference for Group C remained basically stable across the three sessions. This would be expected since a high percentage of both first and second language words were known from the start. A main effect of sessions, $F(2,52) = 15.86$, $p < .001$, merely implicated the effect of practice: overall speed of naming on Session 3, $M = 11.79$, was faster then on session 1, $M = 14.15$, $F(1,52) = 21.67$, $p < .001$, and Session 2, $M = 14.36$, $F(1,52) = 24.51$, $p < .001$. Reliable main effects of distractor language, $F(1,26) =$

17.62, $p < .001$, and distractor conditions, $F(5,130) = 80.66$, $p < .001$, and a reliable distractor language X distractor conditions interaction, $F(5,130) = 17.49$, $p < .001$, were explored in the following planned comparisons. (The results are presented collapsed across sessions.)

Interference by letters. The direction of effects of letters was as expected for the two language conditions. When the blank and the nonpronounceable pseudoword conditions were compared, interference was evidenced for SL, $F(1,260) = 8.48$, $p < .01$, but not CL trials, $F(1,260) = .49$.

Interference by pronounceability. When the three sessions were combined, interference by pronounceability (nonpronounceable vs. pronounceable pseudowords) occurred on both SL, $F(1,260) = 4.02$, $p < .05$, and CL, $F(1,260) = 5.76$, $p < .05$, trials.

Interference by words. Words produced greater naming latencies than nonwords (between-category words versus pronounceable pseudowords) on both SL and CL trials, $F(1,260) = 27.66$, $p < .001$, and $F(1,260) = 35.73$, $p < .001$, respectively.

Interference by semantic categories. Latencies for naming in the within-category condition exceeded naming in the between-category condition for both SL and CL trials, $F(1,260) = 19.41$, $p < .01$, and $F(1,260) = 14.19$, $p < .01$.

Interference by congruent words. For the congruent word conditions, naming latency for CL trials exceeded that for SL trials, $F(1,260) = 38.38$, $p < .001$. Congruent words facilitated naming relative to the blank condition on SL trials, $F(1,260) = 17.19$. $p < .01$. On CL trials, congruent words were a reliable source of interference compared to the blank condition, $F(1,260) =$

29.48, $p < .001$, but caused less interference than between-category words, $F(1,260) = 13.34$, $p < .01$, and less interference than within-category words, $F(1,260) = 53.58$, $p < .001$. The effect was not due to pronounceability since CL congruent words caused greater interference than pronounceable pseudowords, $F(1,260) = 5.50$, $p < .05$.

SL and CL word interference. No reliable differences between the SL and CL between- and within-category conditions were found, $F(1,260) = 1.15$. Second language words were as disruptive to naming as were first language words.

Group D

The results for Group D also varied only slighly across the three sessions. As with Group C, a reliable main effect of session, $F(2,40) = 8.33$, $p < .01$, indicated that speed of naming was faster at Session 3, $M = 11.01$, than at Session 1, $M = 14.61$, $F(1,40) = 15.69$, $p < .001$, or Session 2, $M = 16.06$, $F(1,40) = 7.96$, $p < .01$. Reliable main effects of distractor language, $F(1,20) = 6.03$, $p < .05$, and distractor conditions, $F(5,100) = 25.27$, $p < .001$, as well as a reliable distractor language X distractor conditions interaction, $F(5,100) = 9.34$, $p < .001$, lead to the planned comparisons presented below. First, it should be noted that the only unpredicted finding was the inversion of the between- and within-category word conditions on the CL trials of Session 2 (See Figure 1). Despite this one oddity, the results were analyzed with the three sessions collapsed, except where indicated to the contrary.

Interference by letters. Nonpronounceable pseudowords caused greater interference than blank pictures on CL, $F(1,200) = 5.06$, $p < .05$, and SL, $F(1,200) = 7.14$, $p < .01$, trials.

Interference by pronounceability. On SL trials, pronounceability was not a source of interference, $F(1,200) = .71$. This was also true of CL trials, $F(1,200) = 1.23$.

Interference by words. Words were a strong source of interference on both SL and CL trials, $F(1,200) = 27.25$, $p < .001$, and $F(1,200) = 39.34$, $p < .001$.

Interference by semantic categories. The effect of semantic categories was significant on SL trials, $F(1,200) = 3.99$, $p < .05$. On CL trials, the effect was not reliable, $F(1,200) = 2.14$, due to the inversion at Session 2. When only Sessions 1 and 3 were included in the comparison, a significant difference was obtained, $F(1,200) = 6.75$, $p < .01$.

Interference by congruent words. CL congruent words slowed naming reliably more than did SL congruent words, $F(1,200) = 20.58$, $p < .001$. Again, congruent words facilitated naming on SL trials, $F(1,200) = 12.32$, $p < .01$. on CL trials, congruent words were a source of interference: congruent words slowed naming relative to blank pictures, $F(1,200) = 43.37$, $p < .001$, but produced faster naming responses than did the between-category word condition, $F(1,200) = 8.56$, $p < .01$, or the within-category word condition, $F(1,200) = 18.93$, $p < .001$.

SL and CL word interference. A reliable difference between the SL and CL between- and within-category conditions was not found, $F(1,200) = 1.25$. Second language words produced as much interference as did first language words.

Discussion

The results indicate that automatic processing of word meaning develops relatively quickly in the course of second language learning. CL word interference was evident for Groups A and B by the third session and commencement of the effect in Group A could be detected by Session 2, only 3 months after Session 1. Subjects in Groups C and D automatically processed the meaning of second language words from the start.

The pattern of interference on SL and CL trials was virtually identical (except for the congruent condition, discussed below). Not only was the pattern the same, but the absolute amount of interference on the SL and CL interlingual trials was fairly similar. As soon as reliable CL interference could be detected, second language words produced as much interference as did first language words. The only exception to this rule occurred for Group A children at Session 3, but, as previously noted, these children could read relatively few of the second language words at that time. The findings suggest that second language words make direct contact with meaning. If second language reading required translation into the first language, children should have been able to shut-off processing of the second language distractor words and ignore their meaning. Instead, the meaning of these words could not be ignored.

Interference by words and semantic categories can be inferred from the tasks used apart from the effects produced by the presence of letters or their pronounceability. Interference by letters and pronounceability was intermittent and, even when it did occur, the amount of interference produced was less than that produced by the word conditions. The effects of words and semantic categories are attributable to the automatic processing of meaning within semantic memory.

In general, semantic interference occurred on both SL and CL trials. A superordinate conceptual representation system serving both language lexicons is implied by this result. We have demonstrated the same finding for bilingual children (Goodman, Haith, Guttentag, & Rao, Note 1). It should be noted that the Group A children did not evidence semantic interference on SL and CL trials although there was slight evidence for an emerging difference on Session 3 for first language words. Either meaning of first and second language words was not processed by categories or "wordness," as opposed to meaning, was all that these early readers processed automatically. The absence of semantic interference for Group A was somewhat surprising since monlingual children have been found to evidence semantic interference after only 6 months of reading instruction (Guttentag & Haith, 1980). It is possible that learning to read in two languages simultaneously slows the development of semantic interference. But, because the children in the Guttentag and Haith (1980) study may have been trained to read by methods different from those used for our second language learners, further research is necessary to investigate this possibility.

The congruent effect demonstrated here has also been found with bilingual readers (Goodman, Haith, Guttentag, Rao, Note 1). For both bilinguals and second language learners, SL congruent words facilitated naming. This finding could reflect the fact that both the picture and the distractor word have the same name and that, no matter which is processed first, the correct response can be quickly emitted. Another possibility that cannot be dismissed is that the subjects merely ignored the instructions for the SL congurent condition and read the distractor word rather than naming the

the picture. Therefore, little can be said conclusively about the SL congruent condition. The CL congruent condition is of greater interest. For bilingual and second language learners, CL congruent words served as a source of interference and facilitation depending on the contrast condition on which one focuses. Congruent words slowed naming relative to the blank condition and thus were interfering. But, they facilitated naming when compared to the between- or within-category words. Several interpretations of this finding are possible. We prefer one that depends on facilitation of semantic access coupled with response competition. In the CL congruent condition, the same meaning is contacted by both the picture and the word; the semantic access should be facilitated. On the other hand, if one assumes that the printed word directly primes a naming response, the subject may need to choose in which of the two languages to respond and suppress emission of the other. This checking and suppression process requires time and serves as a source of interference.

Reference Note

1. Goodman, G., Haith, M. M., G[illegible]g, R. E., & Rao, S. Automatic processing of word meaning by bilingual children: Intralingual and interlingual interference, manuscript under editorial review, 1980.

References

Albert, M. L., & Obler, L. K. The bilingual brain. New York: Academic Press, 1978.

Golinkoff, R. M., & Rosinski, R. R. Decoding, semantic processing, and reading comprehension skill. Child Development, 1976, 47, 252-258.

Guttentag, R. E., & Haith, M. M. Automatic processing as a function of age and reading ability. Child Development, 1978, 49, 707-716.

Guttentag, R. E., & Haith, M. M. A longitudinal study of word processing by first-grade children. Journal of Educational Psychology, 1980, in press.

Kolers, P. A. Interlingual facilitation of short term memory. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 311-319.

Rosinski, R. R. Picture-word interference is semantically based. Child Development, 1977, 48, 643-647.

Tulving, E., & Colotla, V. A. Free recall of trilingual lists. Cognitive Psychology, 1970, 1, 86-98.

Table 1

Mean number of words correctly identified on the First and Second Language Picture-Word Matching Tasks

Group	Session 1	Session 2	Session 3
Group A (n = 13)			
First Language	1.5	5.9	9.8
Second Language	0.0	2.4	5.5
Group B (n = 8)			
First Language	11.5	11.6	12.0
Second Language	4.5	10.6	11.4
Group C (n = 27)			
First Language	11.6	11.6	11.6
Second Language	9.4	11.7	11.7
Group D (n = 21)			
First Language	12.0	12.0	11.9
Second Language	12.0	11.9	11.9

Table 2

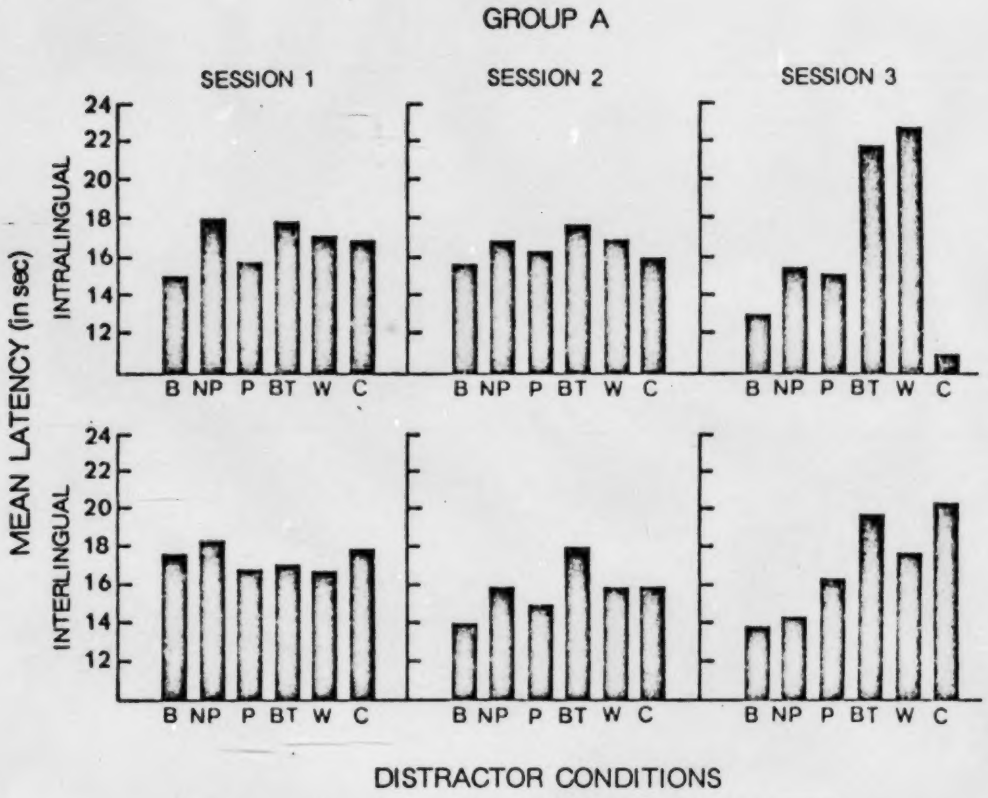
Mean Latency for the Four Experimental Groups on the Six Distractor Conditions of the Same Language and Cross Language Trials[a]

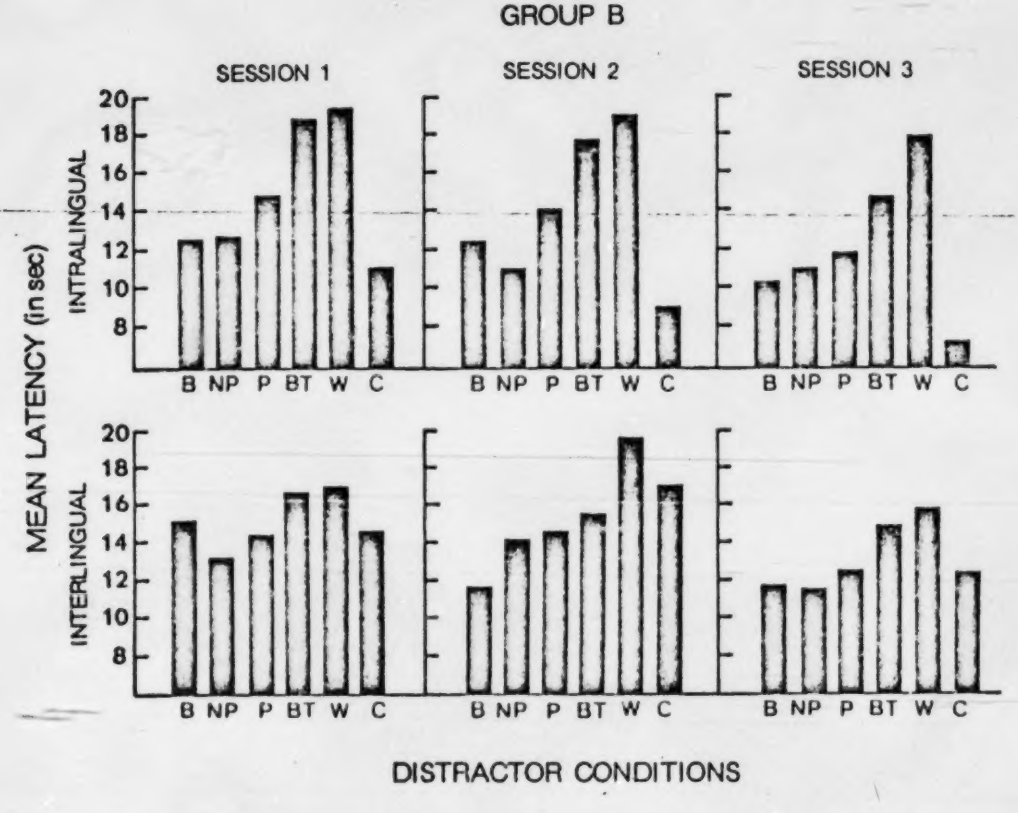
Language Condition	Distractor Condition					
Same Language	Blank	Non-pronouceable pseudowords	Pronounceable pseudowords	Between-Category	Within-Category	Congruent
Group A	14.7	16.6	15.7	19.0	19.0	14.4
Group B	11.8	11.9	13.8	17.4	19.0	9.3
Group C	10.6	11.9	12.9	15.4	17.4	8.6
Group D	11.1	12.6	13.2	16.3	17.5	9.0
Mean	12.1	13.0	13.9	17.0	18.2	10.3
Cross Language						
Group A	15.3	16.1	16.0	18.1	16.4	17.8
Group B	12.9	13.0	13.9	15.7	17.4	14.5
Group C	11.6	11.9	13.1	15.9	17.6	14.2
Group D	11.3	12.6	13.2	16.9	17.8	15.2
Mean	12.7	13.4	14.1	16.7	17.3	15.4

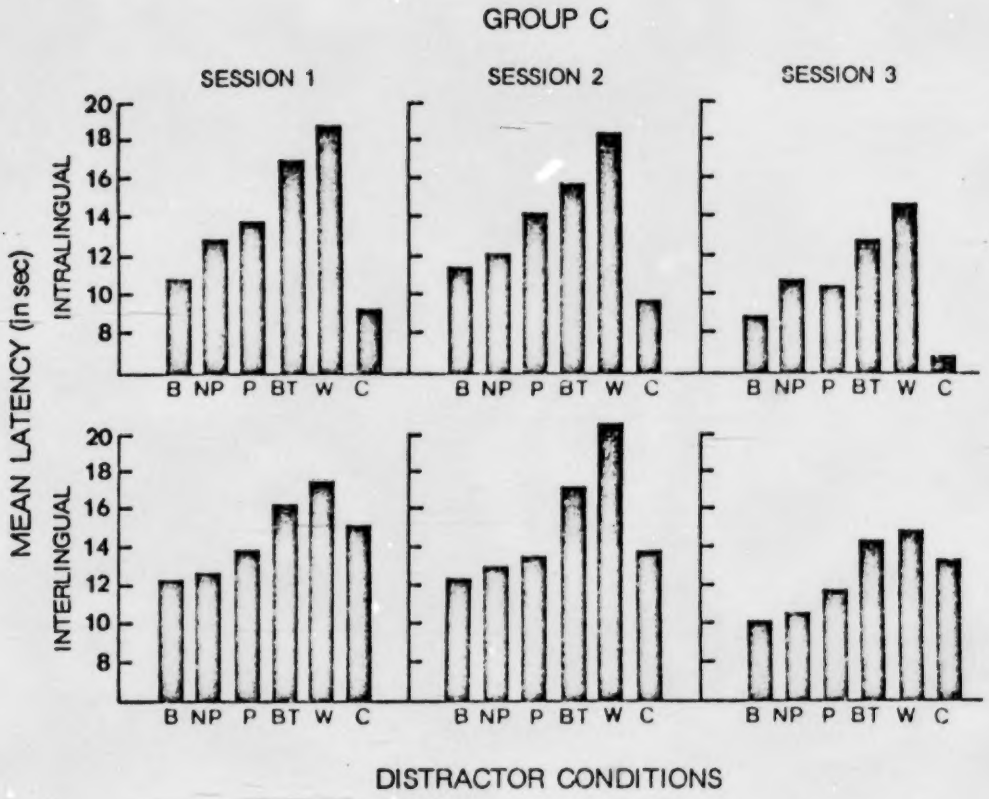
[a]Collapsed across Sessions.

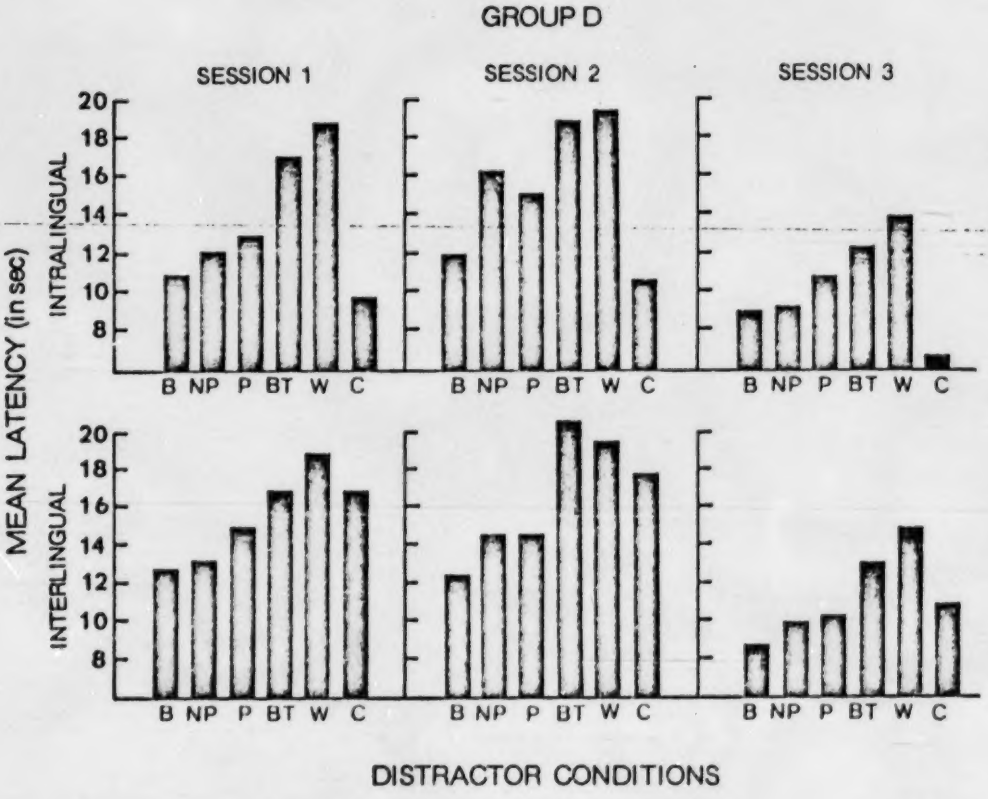
Figure Caption

Figure 1. Mean latency across sessions for the four ability groups on the Same Language and Cross Language distractor trials.


GROUP A
SESSION 1
SESSION 2
SESSION 3
MEAN LATENCY (in sec)
INTRALINGUAL
INTERLINGUAL
24
22
20
18
16
14
12
B NP P BT W C
DISTRACTOR CONDITIONS


GROUP B
SESSION 1
SESSION 2
SESSION 3
MEAN LATENCY (in sec)
INTRALINGUAL
INTERLINGUAL
20
18
16
14
12
10
8
B NP P BT W C
DISTRACTOR CONDITIONS


GROUP C
SESSION 1
SESSION 2
SESSION 3
INTRALINGUAL
INTERLINGUAL
MEAN LATENCY (in sec)
20
18
16
14
12
10
8
B NP P BT W C
DISTRACTOR CONDITIONS


GROUP D
SESSION 1
SESSION 2
SESSION 3
INTRALINGUAL
INTERLINGUAL
MEAN LATENCY (in sec)
20
18
16
14
12
10
8
B NP P BT W C
DISTRACTOR CONDITIONS